REMARKS

Claims 16-23, 39, and 42-56 are all the claims pending in the application. By this Amendment, Applicants cancel claims 24 and 25, and add new claims 42-56.

I. Election Affirmation:

As requested by the Examiner, Applicants affirm the election, without traverse, to prosecute the invention of Group I (claims 16-23 and 39).

Applicants cancel claims 24-25, without prejudice or disclaimer, for being directed to a non-elected invention.

II. Information Disclosure Statement:

In numbered paragraph 6 of the Office Action, the Examiner requests Applicants to provide "Sheet 2 of 2" of the Form 1449 for the Information Disclosure Statement filed February 6, 2002. A courtesy copy of the requested sheet is enclosed.

III. Specification:

The Examiner objects to the Abstract of Disclosure for the reasons noted at numbered paragraph 7 of the Office Action. To address the Examiner's concerns, Applicants cancel the Abstract presently on file in favor of the new Abstract of the Disclosure accompanying this response. If any amendment to the new Abstract is believed to be necessary, the Examiner is invited to contact the undersigned to discuss any proposed changes to the same.

IV. Claim Rejections Under 35 U.S.C. § 112(2nd):

The Examiner rejects claims 16-21 and 29 under 35 U.S.C. § 112(2nd) for the reasons noted at numbered paragraphs 10-14 of the Office Action. Applicants amend some of the claims to address the Examiner's concerns. Some of the amendments are discussed below.

With respect to claims 16-18, Applicants delete the objectionable term "specifying the zero concentration of said specific component." As amended, claims 16-18 define a method that involves calibrating a detection output of the gas sensor by --*determining a zero point*--, which indicates a zero concentration of said specific component, --*based on a detection output of the gas sensor in atmosphere*--. Exemplary embodiments of this calibration step are discussed throughout the specification. For example, see the first full paragraph on page 42.

The term "zero point" is used to represent a point of the detection output that corresponds to zero concentration. An exemplary graph (marked with a "ZERO POINT" legend) is enclosed for the Examiner's consideration. The "ZERO POINT" graph shows the "zero point" as an output value of the sensor at zero concentration (which is the known concentration in atmosphere). Put differently, the "zero point" of the sensor is calibrated (or corrected) based on the detection output of the gas sensor in atmosphere (which is used as a standard). This is consistent with the plain meaning of the term "calibrating."

Turning to the next point, Applicants amend claims 16-19 to correct the antecedent basis and typographical errors noted at numbered paragraph 11-12 of the Office Action.

With respect to claim 39, Applicants amend step (6) by deleting the reference to "step (4)." As amended, step (6) involves "calibrating" the sensor, which is separate and distinct from the limitation recited in step (4). Applicants also amend step (6) by deleting the objectionable term "calibrating zero point" in favor of --*calibrating the basic NOx concentration determination by determining a zero point, which indicates a zero concentration of NOx, based on measuring an electric current flowing through the ceramic body between the electrodes when atmospheric air is introduced into the flow channel*--. For an explanation of this limitation, Applicants refer the Examiner to the explanation above with respect to claims 16-18.

Applicants respectfully assert that the amended claims more particularly point out and distinctly claim the subject matter regarded as the invention, thereby overcoming all of the raised rejections under § 112(2nd).

V. Claim Rejections on Prior Art Grounds:

The Examiner rejects the claims as follows:

1. claims 16-20, 22, 23, and 39 under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over SAE Paper No. 970,858 by Kato et al. ("Kato '858");
2. claims 16, 17, 22, and 23 under 35 U.S.C. § 102(b) as being anticipated by U.S. 4,676,213 to Itsuji et al., ("Itsuji") alone or in combination with "Exhaust Gas Sensors" from Automotive Electronics Handbook, 1995 by Weidenmann et al. ("Weidenmann"); and
3. claim 21 under 35 U.S.C. § 103(a) as being obvious over Kato '858 in view of U.S. 5,953,907 to Kato et al., ("Kato '907").

Applicants respectfully traverse these rejections in view of the following remarks.

All of the independent claims recite (albeit in different formats) a "zero point" calibration feature. That is, as discussed above in section IV, the "zero point" of the sensor is calibrated (or corrected) based on the detection output of the gas sensor using as a standard (e.g., atmosphere). This feature is advantageous because it takes into account change in the characteristics of the sensor that occur over a prolonged use.[1] At least this feature, in combination with the other limitations recited in the independent claims, is not taught or suggested by the prior art relied upon by the rejection grounds.

A. The Kato '858 Reference:

The Examiner considered Kato '858 as teaching a method for detecting the concentration of the specific component in an exhaust gas, including calibrating the sensor to known NOx concentrations, and fitting the sensor's current response to a line for detection in subsequent measurements. Based thereon, the Examiner concluded that Kato '858 teaches detecting the concentration of a specific component based on the calibrated detection output.

In reference to Fig. 2(a), Kato '858 fits certain measurements of known NOx concentrations to a line. However, Kato '858 does not disclose calibrating the sensor in atmospheric air as required by claims 16 (and new claims 42 and 49), or calibrating the sensor upon cutting fuel supply as required by claim 17 (and new claims 43 and 50), or calibrating the sensor upon setting a rich air-to-fuel ratio as required by claim 18 (and new claims 44 and 51), or

claim 16 say "atmosphere" not atmosphere air.

[1] See Spec., p. 3, second full paragraph.

calibrating the sensor under certain driving conditions as required by claims 22, 23, and 39 (and new claims 48 and 54-56).

not required by claims

In fact, Kato '858 has no disclosure with respect to calibrating the sensor while operating the internal combustion engine. This advance in the art allows for the calibration to take into account a change in the characteristics of the sensor upon prolonged use. This is just not achieved by setting a simple line calibration as shown in Kato '858.

what about figs 7&8?

The "simple" line of Kato. reads on claims

Turning to the next point, Applicants respectfully submit that Kato '858 does not disclose any "zero point" calibration as defined by the present invention. Instead, Kato '858 teaches the "correct linearity" under the different temperature conditions. The underlying prerequisite concept (or belief) of this teaching (conclusion) of Kato '858 resides in that the NOx sensor can detect the current NOx concentration without zero point calibration.

disagree zero point of Kato was determine. It turned out to be zero in most examples

More specifically, on page 202 of Kato '858, at (1) only, the temperature dependency was checked and the conclusion was almost no (or minimal) temperature dependency on the linearity. Kato '858 altogether fails to teach or suggest a need of zero point calibration. The Examiner's attention is respectfully directed to Fig. 3 (a) and (b). In both figures, the linear lines cross the zero-ordinate-point. The same applies for Figs. 4(a) and (b) on page 203, although, at (2), A/F dependency was measured.

Although measurement results are plotted and corresponding linear curves are depicted in Figures 4(b), the summary of Fig. 4(a) indicates that "all the plots: R^2=0.987," which should be satisfactory for them.

In short, Kato '858 does not measure the NOx concentration by applying the "zero point" correction. Rather, this reference only plots the "green" measured results obtained without zero point calibration in the graph. At least in this respect, the reference teaches that no calibration would be needed for the NOx sensor. The assertions in the rejection grounds to the contrary are tenable only by placing a strained interpretation on the reference.

Furthermore, the A/F dependency was measured as follows: "The sensor signal was measured in lean (A/F=16.3), stoichiometric point (A/F=14.7) and rich (A/F=13.2) conditions" (page 203, right column, under (2), lines 1-6). Thus there is no zero-point-calibrating measurement in the atmospheric air or other conditions as far as the measured data shown by Figs. 3 and 4 are concerned. The essential objective of the Kato '858 measurements resides in the check of temperature dependency and A/F dependency ranging A/F from 13.2 (rich) to 16.3 (lean). These characteristics are simply not pertinent to the zero-point-calibration of the claimed invention.

B. The Itsuji and Wiedenmann References:

The rejection grounds rely upon Itsuji as allegedly disclosing calibration of an air-fuel ratio sensor (O_2) by measuring the detection output at a particular condition, namely, when the fuel has been cut to the engine, citing column 10, lines 44-51. The rejections grounds cite Wiedenmann as allegedly teaching that calibration at λ=0.8 (as taught by Fig. 10 of Itsuji) corresponds to the claimed "zero point of a detection output". Applicants respectfully disagree.

Figs. 8 and Fig. 10 of Itsuji are simply not pertinent to the "zero point" calibration of the present invention. This is because it would be illogical to implement a "zero point calibration" in the air-fuel ratio (A/F) control. The operating engine of excess air rate λ ranges from 0.5 to 1.5 in Fig. 8 or from 0.8 to "air." These numerical ranges are simply not comparable to a "zero point." Rather the ranges represent a maximum point Ex(max) of λ.

Turning to Wiedenmann, this reference discloses the influence of λ being the normalized A/F ratio on the typical curves for fuel consumption, power, smoothness, and composition of raw exhaust gases in an engine (see Fig. 6.1). The A/F ratio ranges from 0.6 (rich) to 1.7 (lean), across 1.0 (stoichiometrical). The exhaust gas components are O_2, CO_2, HC, CO, H_2 and NOx. Fig. 6.1 shows only the relative tendency of various curves.

However, there is no teaching of the "zero-point" calibration in the sense of the present invention. Wiedenmann is only a general text book which does not discuss the critical problem to improve the measuring precision of the NOx sensor during the prolonged use, which will necessitate the time-to-time correction that is done by the zero-point calibration. In fact, Fig.6.1 of Wiedenmann demonstrates that there is no possibility to achieve the zero-concentration of NOx. At least in these respects, the Wiedenmann references is even less relevant than the Kato '858 reference.

C. The Kato '858 and Kato '907 References:

The shortcomings of Kato '858 have been discussed above in section V.A. In brief, Kato '858 would have led those skilled in the art directly away from the zero-point calibration of the present invention by teaching that the linear curves cross the NOx-zero concentration.

The secondary reference to Kato '907 does not make up for the deficiencies of Kato '858.

More specifically, Kato '907 relates to the detection of deterioration of catalyst/adsorbing means in an apparatus including an A/F control system. The reference does not, however, provide any teachings pertinent to the zero-point calibration, even though there are running conditions where the engine is temporarily changed into a stoichiometric condition or a rich condition. There is simply no correlation between the measured NOx concentration and the A/F ratio or fuel injection (refer to Fig.4 or 5). Kato '907 only teaches that an engine is operated under a rich condition, which plainly means that the engine operation conditions will vary time to time.

Applicants acknowledge that the curve of the NOx exhaust concentration decreases to a lowest level at the last time point D in Figs. 4 and 5. But this does not teach or suggest that a zero-point calibration is performed at this moment.

In Kato '907, the NOx sensor's detection result is presumed to be "correct," which tends to show that this reference does not contemplate (or recognize a need for) any calibration.

For these reasons, Applicants respectfully request the Examiner to reconsider and withdraw all of the raised prior art rejections.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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